COMPARATIVE STUDY OF PHYSICOCHEMICAL PROPERTIES FOR REFINED ARTOCARPUS HETEROPHYLLUS , ANACARDIUM OCCIDENTALE & SYZYGIUM CUMINI SEED OILS

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ABSTRACT

To reduce the impact created by burning fossil fuels on environment, alternative fuels will help us with twin benefits in terms of both power and global warming. Due this pandemic day by day consumption of fruits and dry fruits are increasing drastically by humans for improving their immunity .So, the locally available waste gives you a new channels for production of alternative fuels. A series of experiments on bio-oil and property measurements were performed, analyzed and compared in search of alternative to the rising demand of fossil fuel and its depleting supply around the globe are attempted. Artocarpus heterophyllus, Anacardium occidentale, and Syzygium cumini seed refined oils are considered and examined. These seed oils are high in conjugated fatty acids. Anacardium occidentale, Artocarpus heterophyllus and Syzygium cumini seed oils are Sustainable and biodegradable biofuels with similar properties to petro-diesel fuel. The biochemical and biophysical properties comparative analysis of the selected oils with diesel is presented in this work. fuel properties, such as pH, flash & fire point, redwood viscosity, calorific strength, carbon residue, cloud level, pour point, boiling point, aliphatic / aromatic compounds and hydrocarbons content for the selected oils are reported.

Key words : Bio-oils,S1-Anacardium occidentale seed oil, S2-Artocarpus heterophyllus seed oil and S3-Syzygium cumini seed oil, Physiochemical properties

1. INTRODUCTION

As years go by, utilization of derived fuels is rising tremendously & market to support the use is gradually declining. And it is very clear that the supply of these fossil fuels will vanish within the next ten to twenty years. Science gave birth to something called Alternative Fuel, to fulfil the need for fuel use. Alternative fuels are non-fossil fuel-derived fuels, which are often derived from renewable sources. Alternative fuels consist primarily of Bio-waste-derived ethanol and biodiesel. Biofuels are considered the most promising alternative fueling source. The main reason for approaching the physicochemical properties of an bio-oil is to know the characteristic like boiling point, Calorific value, acidity etc and these characteristics will vary depending on the its composition. Vegetable oils are preferred as alternatives for fossil fuels and have been used for many years. peanut oil was initially used in CI engine by Rudolph Diesel (Shay, 1993). In the current scenario the massive rise in vehicle use often greatly raises the very high demand for the fuel price. Using the alternative fuel will fulfill the demand[1]. Some of the advantages of using these bio oils are lower harmful exhaust emissions, biodegradability, non-toxicity. Bio oils are environmentally friendly, and are also sustainable from agricultural sources. Biodiesel fuel characteristics are largely determined by feedstocks, which differ not only through species but also by processing location[2]. In India we can mainly see the production and usage of oil seed like groundnut, coconut, sunflower, rapeseed, mustard, karanja, Jatropha, Neem, rubber seed, cotton seed, rice bran and tropical fruits such as, Syzygium cumini, Artocarpus heterophyllus and Anacardium occidentale a potentially important indigenous and commercial fruits. These fruits having high amount of vitamins, tannin and anthocyanins. All of these fruit holds with high significant values. There are various factors to be considered for the production of any form of bio oil that are pH value, flash point, fire point, Redwood viscosity, calorific value, carbon residue, cloud point, pour point, boiling point, hydrocarbons. Biodiesel is defined as methyl fatty acid or ethyl esters made from vegetable oils or animal fats as an alternative diesel fuel. It is removable, biodegradable and non-renewable [5, 6]. In this present research, Anacardium occidentale, Syzygium cumini and

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Artocarpus heterophyllus seed oil are used to produce biodiesel.

2. OIL EXTRACTION:

The cashew nut is handled in two ways: first, by roasting it, and second, by soaking it in oil. The oil content of a raw cashew nut shell is over 20%. As a by-product of the oil bath operation, about 10% of the oil is recovered. A further 15% more from the shells by using oil expellers for extraction. As a result, from 1 MT of shells to 100 kg of oil For other two traditional method was followed for extracting oil. Initially collected seed were cleaned & dried at 35 ºC & 60 ºC for lowering the content of moisture in them and size of them was reduced for better extraction of oil content from them [7-10].

$$\% \, Oil \, yield = \frac{Weight \, of \, oil \, extracted}{Total \, weight \, of \, cashew \, nuts \, used} x100$$

2.1 Codes for Oils:

S.No	Code	Oils
1	S1	Anacardium occidentale seed oil
2	S2	Artocarpus heterophyllus seed oil
3	S3	Syzygium cumini seed
4	S4	Diesel

Table-1 Codes for Oils

3. PHYSIOCHEMICAL PROPERTIES ASSESSMENT:

The properties of S1, S2 and S3 bio oils are unblended. These were determined and Testings were undertaken in Koneru Lakshmaiah Education Foundation, chemistry, Bio Technology, Petroleum Civil laboratories, and laboratory of thermal in Narsaraopeta Engineering College.

3.1 pH Value:

The pH value is measured using a pH metre to determine hydrogen ion activity (acidity or alkalinity) in solution. The measurements vary from 0 to 14. The pH of 7 is neutral, the acid is < 7 and the base is > 7.

3.2 Flash and Fire Point:

Using the Kehler Model K-16270 in accordance with ASTM D6751 (Pensky-Martens Closed Flash Tester)Flash and fire points are measured.

3.3 Kinematic viscosity:

It entails measuring the amount of time it takes for a fixed amount of fuel to circulate under gravity through a capillary at a certain temperature ranges (50, 60, 70, 80ºC) and the equipment used for determining the kinematic viscosity is Herzog GmbH MP-480

3.4 Calorific value:

Calorific value was measured by Bomb calorimeter. A chamber filled with pure oxygen and burn it, measuring the amount of heat (i.e. energy) that is generated.

Heat lost by Fuel = Heat gained by Water

$$M_{fuel} * CV = M_{water} * C_p \left(T_2 - T_1 \right)$$

3.5 Carbon Residue:

Carbon residue is measured using normal protocol involving heating of a fuel sample. The H-2495, Conradson Carbon Residue Apparatus is used to check carbon residue and assess the amount of carbon residue left after an oil has been evaporated and pyrolysed, and to show relative propensities to form coke.

3.6 Cloud and Pour Point:

The point of temperature at which wax in oil creates a cloudy appearance. Minimum temperature at which an oil is semi solid & almost loses its characteristics is pour point.

3.7 Boiling point:

Temperature at which liquid vapour pressure equals air and air surrounding pressure transforms into vapour. These oils are more owing due to the increased number of carbon atoms present in the chain. Temperatures at 1 atmosphere where the minimum vapour pressure.

3.8 Aliphatic/Aromatic:

Substance burns with a Smoky flame is considered as Aromatic compound, substance burns with non-smoky flame is considered as Aliphatic compound.

3.9 Pirate test of Hydrocarbons:

The volume, concentration, temperature, and pressure of the hydrocarbon vapors emitted through a preselected vent. A Picrate is a salt or an ester of picric acid compound which picric acid forms with many aromatic hydrocarbons, aromatic amines, aliphatic amines, alkalines, and other compounds.

3.10 Aluminum chloride test of Hydrocarbons:

Polymerization and disproportionation are two processes that result in completely aromatic and partly aliphatic molecules which presence of Anthracene.

3.11 UV spectroscopy:

UV Spectroscopy is used to conduct measurements in UV Spectrometer. Absorbance spectra can recorded and also individual wavelength measurements can conduct, Spectral range of this meter is 200 to 830 nm.

4. RESULTS AND DISCUSSION:

The oil yield is unblended Bio-oil. Physicochemical properties of biooils and results are obtained and calculated the properties of pH value, Flash and Fire points, Cloud and Pour points, calorie value, carbon residue, boiling point, Hydrocarbon test, UV spectroscopy.

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5.1 pH value:

Result of pH value of Biooils are neutral which indicates its suitability of Biofuel, Samples of diesel also in neutral. High temperature over a period of time has degraded and reduced its quality.

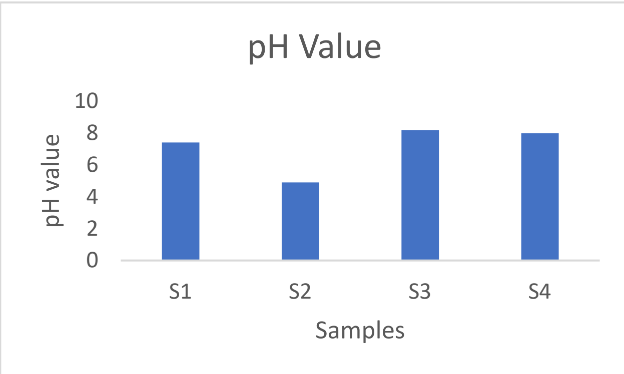

Fig 1: pH value

By analyzing the results for pH value of all samples, S3 shows better results compared to S1 and S2, which is nearer to S4.

5.2 Fire and Flash point:

Compared to diesel bio-oils exhibited low flash & fire values. Higher flash point can also reduce auto ignition. During transportation it reduces fire hazards at high temperatures. Therefore, it is measure of flammability of fuels and also important safety criterion.

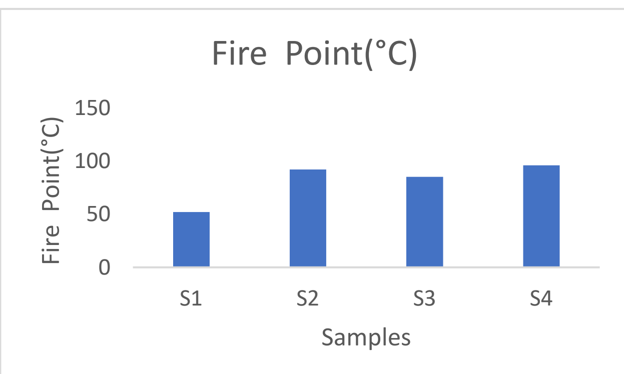

Fig 2: Fire point

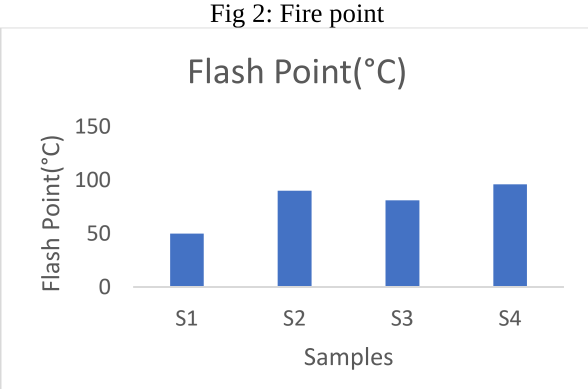

Fig 3: Flash point

By analyzing the results for flash and fire point of all samples, S2 shows better results compared to S1 and S2, which is nearer to S4

5.3 Redwood viscosity:

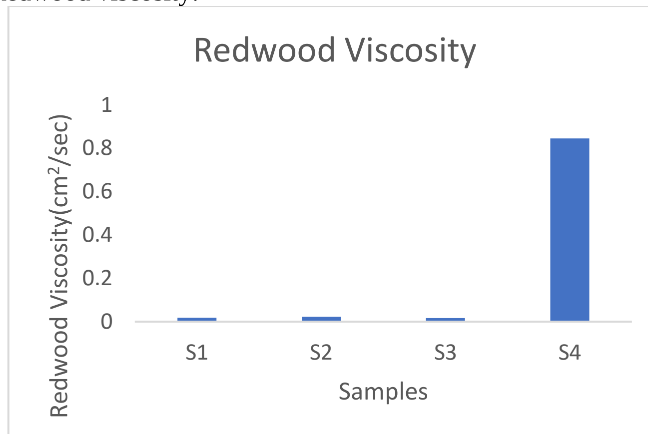

Fig 4: Viscosity

It is One of the essential property which mainly effects injection system. Viscosity is the primary cause of interest in relation and settling rates of contaminants.

By analyzing the results for viscosity of all samples, S2 shows better results compared to S1 and S3, which is nearer to S4.

5.4 Calorific value:

Enthalpy released after completion of combustion at constant pressure or volume. Fuels having higher calorific values it will helps in lower flow rate. Calorific value increases after transesterification, due to glycerol removed from oil.

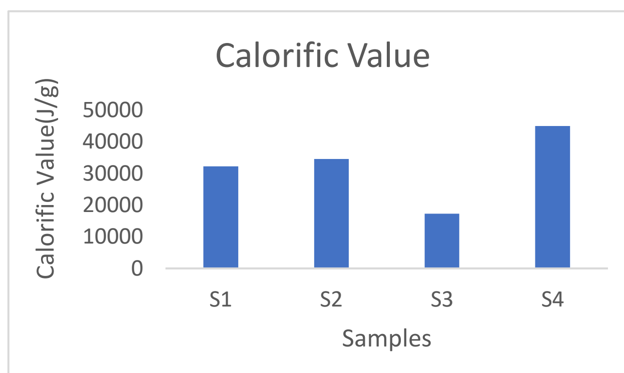

Fig 5: Calorific value

By analyzing the results for viscosity of all samples, S2 shows better results compared to S1 and S3, which is nearer to S4.

5.5 Carbon residue:

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After burning of sample of Bio-oil, subjected to thermal decomposition. Therefore the test gives indication of cooking tendency. Excessive level of carbon residue is inadequate purification and also organic impurities.

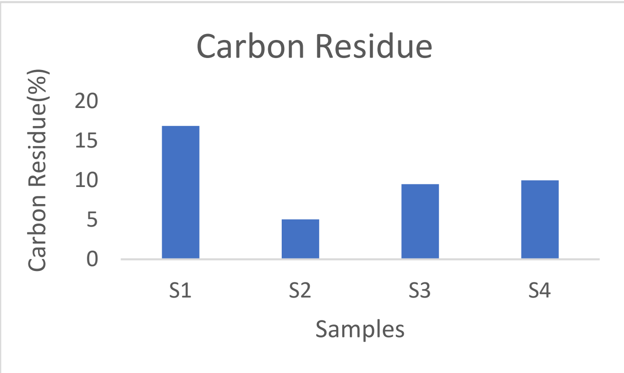


Fig 6: Carbon residue

By analyzing the results for viscosity of all samples, S3 shows better results compared to S1 and S2, which is nearer to S4.

5.6 Cloud and Pour point:

Frozen oil can clog filters and starve the engine, so it's important to pay attention to how it behaves. Cloud and pour points will cause cold soak filter plugging at above 0°C in cold temperature behavior of fuels.

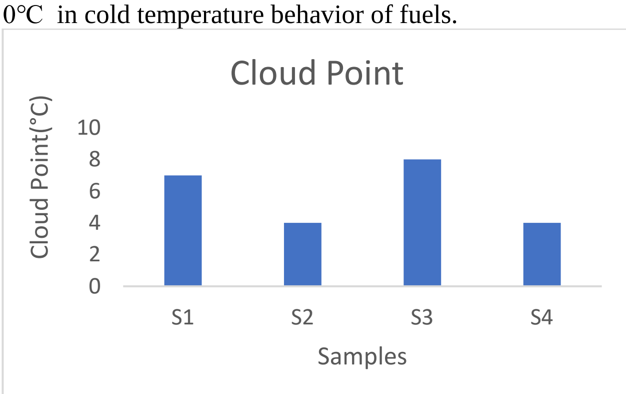
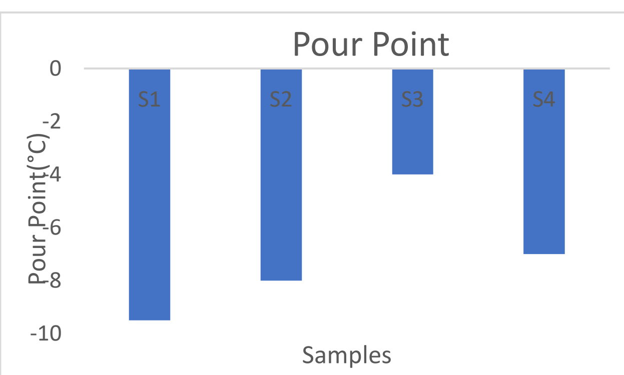


Fig 7: Cloud point



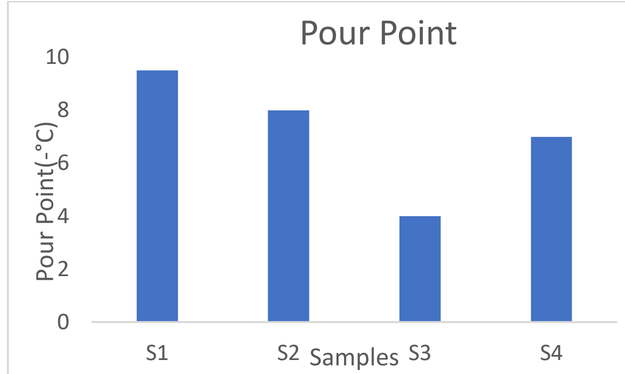


Fig 8: Pour point

By analyzing the results for Cloud point of all samples, S3 shows better results compared to S1 and S2, which is nearer to S4.

5.7 Boiling point:

Over a temperature range of Bio-oil, opposed to having a single point for a pure compound. The range of boiling covers the temperature interval from the initial boiling. The boiling range for oil may exceed 500°C.

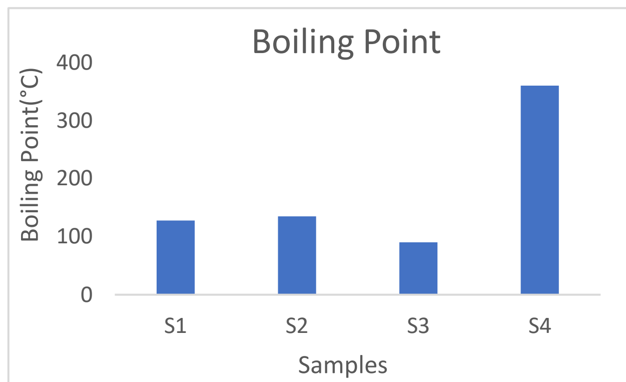


Fig 9: Boiling point

By analyzing the results for viscosity of all samples, S2 shows better results compared to S1 and S3, which is nearer to S4.

5.8 Flame test:

2ml quantity of biooil in a clean and dry spatula is introduced into the flame. When the substance burns with smoky flame subjected to aromatic compound, substance burns with non smoky flame subjected to aliphatic compound. Based on each element's signature emission spectrum, detect the presence of some elements, mainly metal ions.

S1	S2	S3	S4
Substance burns with smoky flame which indicates aromatic compound	Substance burns with smoky flame which indicates aromatic compound	Substance burns with smoky flame which indicates aromatic compound	Substance burns with smoky flame which indicates aromatic compound

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Table no.3: Flame test results

5.9 Pirate test of hydrocarbons:

Pinch of picric acid with 5ml of biooil is taken and shaken gently, in a hot condition a yellow precipitate observed which indicates presence of naphthalene, when red precipitate is observed which indicates presence of Anthracene.

S1	S2	S3	S4
Observed Red Color so, Presence of Anthracene	Observed Red Color so, Presence of Anthracene	Observed Red Color so, Presence of Anthracene	Observed Red Color so, Presence of Anthracene

Table no.4: Pirate test results

5.10 Aluminum chloride test of hydrocarbon:

5ml of biooil dissolve in chloroform and add anhydrous aluminum chloride. Alcl3 crystals attain yellow color but turns to deep orange within few minutes which indicates presence of benzene, when chloroform layer is colourlessAlCl3 crystals turn to orange colour which indicates presence of toluene, when choloroform layer is yellow in colour green colour occurs immediately which on standing turns toluene colour pale greenish yellow colour indicates presence of naphthalene, when choloroform layer is colourless which indicates presence of Anthracene.

S1	S2	S3	S4
Observed Colorless so presence of Anthracene	Observed Colorless so presence of Anthracene	Observed Colorless so presence of Anthracene	Observed Colorless so presence of Anthracene

Table no.5: Aluminum chloride test results

5.11 UV spectroscopy:

UV absorbance feature obtained with Bio-oil of undefined path length onto a wall, Bio-oil spectra exhibits a number of well-resolved peaks. UV/VIS spectrometer, with a graphical output and a non-linear wavelength scale.

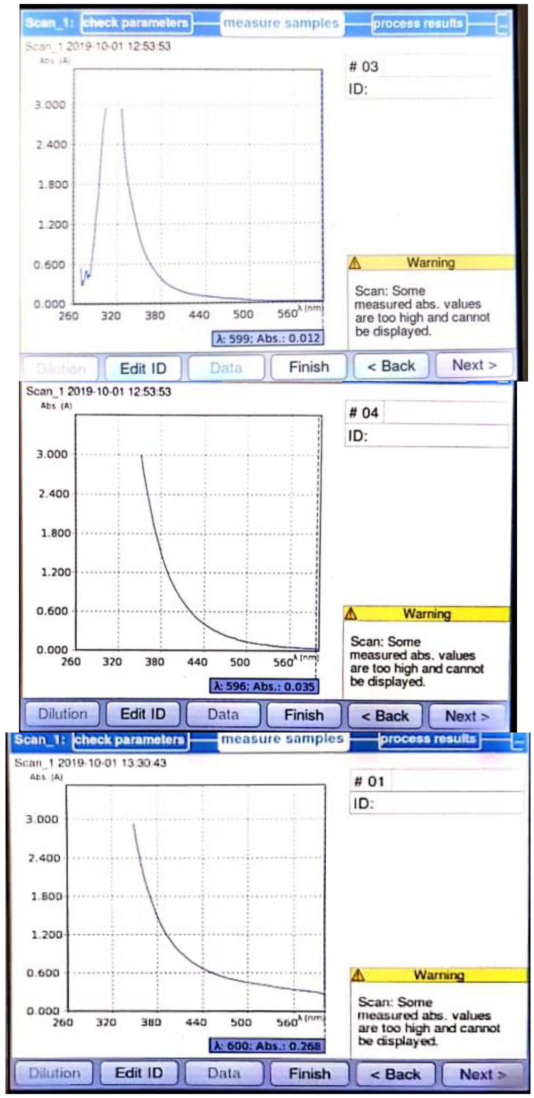

Fig 10: UV spectroscopy

5. CONCLUSION

Many of the properties of the biooils are below the limits for biodiesel, according to the experimental data, and they can be utilized as alternative fuel for engines.

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